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CLCEQN - A MICROCOMPUTER PROGRAM THAT EVALUATES A NUMBER OF PARAMETRIC EQUATIONS

K. Bartels and P.L. Bedard
Metallurgical Chemistry Section
Extractive Metallurgy Laboratory

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CLCEQN - A MICROCOMPUTER PROGRAM THAT EVALUATES A NUMBER OF PARAMETRIC EQUATIONS

by

K. Bartels* and P.L. Bedard**

SUMMARY

CLCEQN is a computer program which evaluates thirteen parametric equations often needed in the scientific laboratory. The chosen equations represent a broad base of functions including linear, parabolic and exponential expressions of the type Y=f(X). To evaluate any of the given equations, it is only required that the equation coefficients be provided. The program has been written in Microsoft BASIC-80*** and is intended to run on any of the popular microcomputers for which an "extended" type of BASIC is available. Care has been taken to make data entry "user-friendly". CLCEQN, therefore, may be run on most microcomputers by personnel who may have little or no experience in high-level language programming. It is screen oriented and provides a high level of user prompting, error checking and, as output, provides a printed listing of the generated data. In addition, the user may request that the generated data file be written to diskette should further processing be necessary.

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* Chemist, ** Technologist, Metallurgical Chemistry Section, Mineral Sciences Laboratories, CANMET, Energy, Mines and Resources Canada, 555 Booth Street, Ottawa, Ontario, K1A 0G1.

*** Microsoft BASIC-80, Trademark, Microsoft Corporation, Microsoft Building, 10700 Northrup Way, Bellevue, Washington 98004, U.S.A.

RESUME

CLCEQN est un programme d'ordinateur rendant capable l'évaluation de treize équations parametriques générales utilisées souvent dans les laboratoires scientifiques. Les équations choisies représentent une vaste base de fonctions: linéaire, parabolique ainsi que des expressions exponentiel de type Y=f(X). Cela requiert seulement que les coefficients d'équation soient connus pour les fonctions à être évaluées. Le programme a été écrit dans le langage "Microsoft BASIC-80" et est destiné à fonctionner sur n'importe quel micro-ordinateur populaire pour lequel une version de "BASIC" est disponible. Beaucoup de soin a été pris pour fair l'entrée de donnée a l'amiable. Par conséquent CLCEQN peut fonctionner sur la majorité des micro-ordinateurs par un personnel qui ne requiert aucun haut niveau de connaissance en programmation. Il est spécialement conçu pour l'utilisation de l'écran et pourvoit un haut niveau de guidage de l'utilisateur, correction d'erreurs et pourvoit comme sortie un imprimé des résultats générés. En plus, l'utilisateur peut demander à ce que la filière générée soit écrite sur un mini-disque pour une opération future si nécessaire.

INTRODUCTION

Recently, there have been many microcomputer acquisitions in the scientific laboratories within Energy, Mines and Resources and, certainly, more will be installed in the near future. With an increased use of microcomputers, programs will be written by individual users for specific purposes. CLCEQN, written in-house, is such a program. CLCEQN has been found to be very useful within the laboratory and it may also serve other scientific microcomputer users. Therefore, this report serves as documentation for the use and source code of CLCEQN.

In designing CLCEQN, an attempt was made to write a program which could be easily executed by non-programmers. It is one of the major advantages of microcomputers that, given the availability of "user-friendly" software, users who are not themselves programmers may take full advantage of the computational, word processing or record/database keeping abilities of microcomputers. Therefore, it is only necessary for the user to provide the required coefficients and to follow the instructions on the screen to generate the desired interpolated data in X and Y.

PROGRAM DESCRIPTION

PROGRAM CONCEPT

CLCEQN enables users to calculate, print and save a data file of interpolated values in X and Y for thirteen (Table 1) general parametric equations of the type Y=f(X). The user selects one of the equations and then enters the coefficients of X, the interpolation range and the iteration interval at the keyboard. From these the program calculates the corresponding values Y_n for the requested values of X_n over the range X_{min}, X_{min} + delX,

X_{max}. Here X_{min} and X_{max} are the minimum and maximum values of X for which the independent variable Y is to be determined and delX is the interpolation interval. At present, CLCEQN supports only thirteen general equations, but users who are familiar with the BASIC language may easily add their own.

Table 1. Equations presently supported by CLCEQN

1.	$Y = B_1X + B_2$
2.	$Y = B_1X^2 + B_2X + B_3$
3.	$Y = B_1X^{B_2X} + B_3$
4.	$Y = B_1X^{B_2X^2} + B_3$
5.	$Y = B_1eB_2X + B_3$
6.	$Y = B_1eB_2X^2 + B_3$
7.	$Y = B_1XeB_2X + B_3$
8.	$Y = B_1XeB_2X^2 + B_3$
9.	$Y = B_1X^2eB_2X + B_3$
10.	$Y = B_1X^2eB_2X + B_3X + B_4$
11.	$Y = B_1eB_2X + B_3X + B_4$
12.	$Y = B_1eB_2X^2 + B_3X + B_4$
13.	$Y = (B_1 + B_2X)/(1 - B_3X)$

DETAILS OF DATA ENTRY

CLCEQN has been designed to make full use of BASIC's ability to prompt the user for the required information, request it in the correct sequence and provide for error correction prior to computation should incorrect data entry occur at the keyboard. In addition, to speedy data entry, correction prompting may be turned off if so desired. The following is the sequence of screen prompts and queries initiated by CLCEQN:

Screen 1

CLCEQN Logo, author and version information and inquiry whether short on-screen instructions should be displayed.

Screen 1b

Additional on-screen instructions if previous inquiry was answered with a yes.

Screen 2

Inquiry as to need for correction prompting.

Request for date.

Prompt notifying user to initialize printer.

Screen 3

Request for the SAMPLE number, CATALOG number or other IDENTIFIER of this calculation.

Screen 4

Request for number of comment lines required (maximum of 5 lines allowed).

Screen 5a-e

Request for keyboard entry of up to five comment lines, each line of comment on a subsequent screen.

Screen 6

A listing of the thirteen equations which are presently incorporated in CLCEQN and a request to choose one.

Screen 7a to 7nc

Request to enter each of the coefficients required by the chosen equation where nc is the number of coefficients in the equation.

Screen 8

Request for Xmin, Xmax, delX, name of the independent variable and name of the dependent variable.

Screen 9

Listing of calculation statistics; i.e., the number of data pairs to be processed and the number of lines of output to the printer.
Request whether data should be written to a file.

Screen 9a

If data are to be written to diskette, then a diskette file directory is printed and a file name is requested. Under the CP/M 80* operating system, this file name would normally be in the form of aaaaaaaa.bbb.
Inquiry as to whether or not the specified file is a new one or an old one to which this set of data would then be appended.
Message on the screen that calculations are proceeding.
Message that the file is being written.
Inquiry as to whether another function needs to be evaluated.

NOTE: For a large number of iterations, processing may take one or two minutes on an 8 bit machine running under control of CP/M 80* using a 4 Mhz Z80A**. This is especially true since X,Y and B variables have been declared double precision. A compiled version of CLCEQN executes much faster and is recommended when a large number of iterative calculations are required.

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* CP/M 80 is a registered trademark of Digital Research

** Z80A is a registered trademark of Zilog Corporation

PROGRAM EXAMPLE

A typical use of CLCEQN is that of calculating unknown concentrations from a known calibration curve; e.g., one of concentration versus temperature. Assuming that temperature is the independent variable and that changes in concentration with respect to temperature closely follow a parabolic relationship, the general function C=f(T) may be written as

$$C = B_1T^2 + B_2T + B_3 \qquad \text{(Eq. 1)}$$

where B_1, B_2 and B_3 are the coefficients of T.

Assuming that a concentration versus temperature calibration has established that $B_1 = 0.00984$, $B_2 = 0.146$ and $B_3 = 0.775$ and that it is necessary to know the concentration from 25 to 30 degrees every 0.1 degrees, it is now possible to run CLCEQN and print out a table of interpolated values of C vs T for the required range. It is also possible to save this data file to discette so that it can be used for further processing; e.g., as input to a plotting program. In addition to the table of interpolated values, a printout of the date, the sample number, catalog number or other identification, up to five comment lines, the equation coefficients, the range and iteration characteristics as well as the titles of the X and Y variables are provided.

Given that parabolic equation no. 2, the above coefficients and iteration characteristic were chosen and that the following was entered at the keyboard:

a) Date: FEB 28/84

b) Sample Identifier: LEAD #34

c) Comment: LEAD CONCENTRATION FROM 25 TO 30°C

d) Title of X variable: TEMPERATURE (°C)

e) Title of Y variable: CONCENTRATION (g/L)

a printout such as that shown in Appendix I is obtained. As may be seen, all relevant data have been included in the printout. In this example, the data in the table have also been written to a data file called TEST.DAT, a printout of which is shown in APPENDIX II. TEST.DAT may be utilized further in a plot program or as input to another computer program.

This would complete a typical run of CLCEQN. At the end of the program the user has the option of proceeding with another calculation or stopping the program.

DESCRIPTION OF SOURCE CODE

A complete listing of the BASIC source code and a cross-reference table of the variables and statement entries for CLCEQN is given in Appendix III. The source code documentation includes general comments, a list of variables and an explanation of how these are used. In addition, the following should be noted:

a) Hardware dependent installation

To enhance both screen and printer output, several control codes have been defined. These are CLEAR SCREEN (CLS$), INVERSE VIDEO ON (RO$), INVERSE VIDEO OFF (RF$) and COMPRESSED PRINT (CMP$). These are located at line 2330 in the subroutine beginning at line 2270 and should be changed to those required for a particular hardware configuration. Control sequences used in this program are those for the "NorthStar Advantage" microcomputer. Control sequences not supported by a particular terminal should be set to "null".

b) DIMensioning of the program

The present version of this program has been DIMensioned to allow 1001 iterations (variables X and Y). A "subscript out of range" error will occur if this DIMensioning is exceeded but may easily be changed at line 720.

The number of equations (variable EQN) that are presently supported is 20. This may also be easily changed at line 720 and at line 740 where the number of equations (variable IEQ) should be increased accordingly.

It should also be noted that the maximum number of coefficients (variable B) allowed per equation is 8 and the maximum number of comment lines (variable M$) is presently set to five. These may also be adjusted in line 720.

c) Adding or changing equations

Should there be need to add an equation or to change one which is presently supported, the user should make the alteration or addition at lines 2410-2530 (the alphanumeric strings of each equation), at lines 3060-3570 (the actual computation code for each equation) and change the DATA statement at line 730 to reflect accurately the number of coefficients in each of the equations.

For example, if one wishes to force the Y-intercept in equation one to zero (0) without repeatedly entering a value of zero for B(2), the following changes must be made to the source code:

```
line 730     Old version:  DATA 2,3,3,3,3,3,3,3,3,3,4,4,3
             New version:  DATA 1,3,3,3,3,3,3,3,3,3,4,4,3

line 2410    Old version:  EQN(1)="1. B(1) * X + B(2)"
             New version:  EQN(1)="1. B(1) * X"

line 3070    Old version:  Y(I)=B(1)*X(I)+B(2)
             New version:  Y(I)=B(1)*X(I)
```

Thus, the first character of the DATA statement (line 730) has been changed to reflect that there is now only one coefficient in equation 1, since the second coefficient B(2), the Y-intercept, has been eliminated from the alphanumeric description string and from the actual equations in lines 2410 and 3070, respectively.

d) Program and system requirements and program availability

CLCEQN is written in Microsoft BASIC-80, requiring at least 24K of RAM memory for the Microsoft BASIC-80 Interpreter. Use of a version compiled with the Microsoft BASIC-80 Compiler is strongly recommended due to the greatly increased processing speeds. After loading the operating system, the interpreter and this version of CLCEQN as it is DIMensioned, only about 4700 bytes of RAM memory remain unused in the TPA (Transient Program Area) of a typical 64K RAM microcomputing system. Thus, only a slight increase in the size of the data arrays is possible.

For those users having MODEM, PACX or DATAPAC communication capability to the CYBER computing system at EMR, CLCEQN may be downloaded to their system via the CYBER. The program will shortly be stored on the CYBER system and users wishing a copy of the program should contact the authors.

CONCLUSION

CLCEQN is a useful BASIC version of an older FORTRAN program which was executed as punched cards and later as a batch job over an interactive terminal. This program is eminently suited to a microprocessor in that it enables easy data entry and use by personnel not expert in high-level language programming. In addition to avoiding the considerable costs associated with batch processing in a time-sharing mainframe environment, the ability to interact directly with the program is invaluable.

ACKNOWLEDGEMENT

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APPENDIX I

PRINTOUT OF RESULTS PRODUCED BY CLCEQN

FEB 28/84 = = = CLCEQN = = =

- THE SAMPLE NUMBER AND THE COMMENTS ARE AS FOLLOWS:

... LEAD #34

... Lead Concentration from 25 to 35'C

- EQUATION NUMBER 2 HAS BEEN CHOSEN. IT READS:

2. Y = B(1) * X^2 + B(2)*X + B(3)

- THE 3 EQUATION COEFFICIENTS ARE:

... B(1)= 0.00984000
... B(2)= 0.14600000
... B(3)= 0.77500000

- THE REQUESTED ITERATION PARAMETERS ARE AS FOLLOWS:

... XMIN= 25
... XMAX= 30
... DELX= .1

TABLE OF CALCULATED VALUES OF 'Y' FOR A RANGE OF GIVEN 'X'

Temperature ('C) VS Concentration (g/l)

'X'	'Y'	'X'	'Y'	'X'	'Y'	'X'	'Y'	'X'	'Y'
25.000D+00	10.575D+00	25.100D+00	10.639D+00	25.200D+00	10.703D+00	25.300D+00	10.767D+00	25.400D+00	10.832D+00
25.500D+00	10.896D+00	25.600D+00	10.961D+00	25.700D+00	11.026D+00	25.800D+00	11.092D+00	25.900D+00	11.157D+00
26.000D+00	11.223D+00	26.100D+00	11.289D+00	26.200D+00	11.355D+00	26.300D+00	11.421D+00	26.400D+00	11.487D+00
26.500D+00	11.554D+00	26.600D+00	11.621D+00	26.700D+00	11.688D+00	26.800D+00	11.755D+00	26.900D+00	11.823D+00
27.000D+00	11.890D+00	27.100D+00	11.958D+00	27.200D+00	12.026D+00	27.300D+00	12.094D+00	27.400D+00	12.163D+00
27.500D+00	12.232D+00	27.600D+00	12.300D+00	27.700D+00	12.369D+00	27.800D+00	12.439D+00	27.900D+00	12.508D+00
28.000D+00	12.578D+00	28.100D+00	12.647D+00	28.200D+00	12.717D+00	28.300D+00	12.788D+00	28.400D+00	12.858D+00
28.500D+00	12.929D+00	28.600D+00	12.999D+00	28.700D+00	13.070D+00	28.800D+00	13.141D+00	28.900D+00	13.213D+00
29.000D+00	13.284D+00	29.100D+00	13.356D+00	29.200D+00	13.428D+00	29.300D+00	13.500D+00	29.400D+00	13.573D+00
29.500D+00	13.645D+00	29.600D+00	13.718D+00	29.700D+00	13.791D+00	29.800D+00	13.864D+00	29.900D+00	13.937D+00
30.000D+00	14.011D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00

APPENDIX II

PRINTOUT OF THE DATA FILE TEST.DAT PRODUCED BY CLCEQN

25.000E+00 10.575E+00
25.100E+00 10.639E+00
25.200E+00 10.703E+00
25.300E+00 10.767E+00
25.400E+00 10.832E+00
25.500E+00 10.896E+00
25.600E+00 10.961E+00
25.700E+00 11.026E+00
25.800E+00 11.092E+00
25.900E+00 11.157E+00
26.000E+00 11.223E+00
26.100E+00 11.289E+00
26.200E+00 11.355E+00
26.300E+00 11.421E+00
26.400E+00 11.487E+00
26.500E+00 11.554E+00
26.600E+00 11.621E+00
26.700E+00 11.688E+00
26.800E+00 11.755E+00
26.900E+00 11.823E+00
27.000E+00 11.890E+00
27.100E+00 11.958E+00
27.200E+00 12.026E+00
27.300E+00 12.094E+00
27.400E+00 12.163E+00
27.500E+00 12.231E+00
27.600E+00 12.300E+00
27.700E+00 12.369E+00
27.800E+00 12.439E+00
27.900E+00 12.508E+00
28.000E+00 12.578E+00
28.100E+00 12.647E+00
28.200E+00 12.717E+00
28.300E+00 12.788E+00
28.400E+00 12.858E+00
28.500E+00 12.929E+00
28.600E+00 12.999E+00
28.700E+00 13.070E+00
28.800E+00 13.141E+00
28.900E+00 13.213E+00
29.000E+00 13.284E+00
29.100E+00 13.356E+00
29.200E+00 13.428E+00
29.300E+00 13.500E+00
29.400E+00 13.573E+00
29.500E+00 13.645E+00
29.600E+00 13.718E+00
29.700E+00 13.791E+00
29.800E+00 13.864E+00
29.900E+00 13.937E+00
30.000E+00 14.011E+00

APPENDIX III

LISTING AND CROSS REFERENCE TABLE FOR CLCEQN

```
100 REM                          == CLCEQN ==
110 REM
120 REM - THIS PROGRAM EVALUATES SEVERAL COMMONLY USED PARAMETRIC EQUATIONS
130 REM   OF THE TYPE Y=F(X). EQUATION COEFFICIENTS MUST BE PROVIDED -
140 REM
150 REM - BY K. BARTELS AND P. BEDARD (CANMET-EMR, JANUARY 1984) -
160 REM
170 REM - VARIABLES USED -
180 REM
190 REM ANS .... QUERY RESPONSE
200 REM AZ ..... INTERIM CALCULATION VARIABLE
210 REM B ...... ARRAY OF EQUATION COEFFICIENTS
220 REM D$ ..... DATE
230 REM D1260 .. STRING VARIABLE
240 REM D340 ... STRING VARIABLE
250 REM DELX ... ITERATION INTERVAL
260 REM EQN .... ARRAY OF EQUATIONS
270 REM FILE$ .. NAME OF DATA FILE
280 REM IEQ .... NUMBER OF EQUATIONS
290 REM IN ..... NUMBER OF DATA PAIRS
300 REM IPR .... PROMPTING VARIABLE
310 REM ISP .... SPACING VARIABLE
320 REM LN ..... NUMBER OF OUTPUT LINES
330 REM LSP .... SPACING VARIABLE
340 REM M ...... NUMBER OF COMMENT LINES
350 REM M$ ..... ARRAY OF COMMENTS
360 REM N ...... EQUATION COUNTER
370 REM NC ..... NUMBER OF COEFFICIENTS
380 REM NEQN ... PARTICULAR EQUATION TO BE EVALUATED
390 REM R$ ..... RESPONSE VARIABLE
400 REM SX ..... SINGLE PRECISION INDEPENDENT VARIABLE (X)
410 REM SXOLD .. EXISTING DATA IN X
420 REM SY ..... SINGLE PRECISION DEPENDENT VARIABLE (Y)
430 REM SYOLD .. EXISTING DATA IN Y
440 REM S2$ .... SAMPLE NUMBER
450 REM TEST ... CONSTANT NEEDED FOR INTEGER DIVISION
460 REM X ...... DOUBLE PRECISION INDEPENDENT VARIABLE
470 REM XFILE .. DATA FILE VARIABLE
480 REM XMAX ... MAXIMUM OF X-RANGE TO BE EVALUATED
490 REM XMIN ... MINIMUM OF X-RANGE TO BE EVALUATED
500 REM XN ..... INTERIM CALCULATION VARIABLE
510 REM XOLD ... EXISTING DATA IN X
520 REM Y ...... DOUBLE PRECISION DEPENDENT VARIABLE
530 REM YOLD ... EXISTING DATA IN Y
540 GOTO 710
550 REM
560 REM - CORRECTION PROMPTING -
570 REM
580 INPUT"  ... is this correct";R$
590 IF LEFT$(R$,1)="Y" OR LEFT$(R$,1)="y" THEN ANS=1 ELSE ANS=0
600 RETURN
610 REM
620 REM - 'CONTINUE' PROMPTING -
630 REM
640 PRINT")) Please hit any key to continue ..."
650 R$=INKEY$
660 IF R$="" THEN 650
```

'CLCEQN.BAS' - APPENDIX III

```
670 PRINT CLS$:RETURN
680 REM
690 REM - DEFINE DIMENSIONED AND SCREEN CONTROL VARIABLES AND SET CONSTANTS -
700 REM
710 DEFDBL B,X-Y:DEFSTR E
720 DIM X(1001),Y(1001),M$(5),B(8),EQN(20)
730 DATA 2,3,3,3,3,3,3,3,3,3,3,4,4,3
740 IEQ=13
750 D34$=STRING$(34,"-"):D126$=STRING$(126,"-")
760 GOSUB 2230:REM DEFINE SCREEN AND PRINTER CONTROL
770 PRINT CLS$
780 PRINT SPC(15);D34$
790 PRINT SPC(15);"CLCEQN PROGRAM  VERSION 1.2/JAN 84"
800 PRINT SPC(15);D34$:PRINT
810 PRINT SPC(12);"(BY K. BARTELS AND P. BEDARD, CANMET,EMR)"
820 PRINT SPC(25);"(JANUARY 1984)"
830 PRINT
840 INPUT"}} Do you need instructions (Y OR N)";R$
850 GOSUB 590:IF ANS=0 THEN 1040
860 PRINT
870 PRINT"THIS PROGRAM CALCULATES THE VALUES OF THE DEPENDENT VARIABLE 'Y' FOR"
880 PRINT"A REQUIRED RANGE OF THE INDEPENDENT VARIABLE 'X' IF THE FORM OF THE"
890 PRINT"EQUATION IS KNOWN AND ITS COEFFICIENTS eg.B(1),B(2) ETC. ARE PROVIDED."
900 PRINT"THE USER NEED ONLY ENTER THE VALUES AS REQUESTED BY THE PROGRAM."
910 PRINT"THE USER MAY CHOOSE ANY ONE OF  --)";IEQ;"(--  EQUATIONS PRESENTLY"
920 PRINT"INCORPORATED INTO THE EQUATION SUBROUTINE AND A TABLE OF INTERPOLATED"
930 PRINT"VALUES FOR 'Y' WILL BE PRINTED FOR THE REQUIRED RANGE IN 'X'."
940 PRINT
950 GOSUB 640:REM CONTINUE PROMPT
960 PRINT"PLEASE NOTE:"
970 PRINT
980 PRINT"       1. THE PROGRAM IS PRESENTLY DIMENSIONED FOR A MAXIMUM OF"
990 PRINT"          1001 ITERATIONS AND 20 EQUATIONS AT DIM STATEMENT 720"
1000 PRINT
1010 PRINT"       2. STATEMENT 730 SPECIFIES THE NUMBER OF EQUATIONS THAT"
1020 PRINT"          ARE PRESENTLY SUPPORTED BY 'CLCEQN'."
1030 PRINT
1040 PRINT:PRINT SPC(30);"----------":PRINT
1050 GOSUB 640:REM CONTINUE PROMPT
1060 PRINT:INPUT"}} Do you want correction prompting (Y or N)";R$
1070 GOSUB 590:IF ANS=1 THEN IPR=1 ELSE IPR=0
1080 PRINT:INPUT"}} What is today's date (YY MM DD)";D$
1090 IF IPR=0 THEN 1120
1100 PRINT:PRINT"  ... TODAY'S DATE: ";D$:PRINT
1110 GOSUB 580:IF ANS=0 THEN 1080
1120 PRINT:PRINT"}} Please initialize printer and hit any key to continue ..."
1130 PRINT:GOSUB 650:REM INKEY REQUEST
1140 LPRINT CHR$
1150 LPRINT SPC(4);D126$
1160 LPRINT SPC(4);D$; TAB(59);"= = =  CLCEQN  = = ="
1170 LPRINT SPC(4);D126$
1180 PRINT CLS$
1190 PRINT"}} What is the SAMPLE number, CATALOG number or IDENTIFIER for this calculation"
1200 PRINT:INPUT S2$:PRINT
1210 IF IPR=0 THEN 1240
1220 PRINT"  ...";S2$:PRINT
1230 GOSUB 580:IF ANS=0 THEN 1180
```

'CLCEQN.BAS' - APPENDIX III

```
1240 PRINT CLS$
1250 INPUT"}} How many lines of COMMENTS do you wish to record (MAX=5)";M
1260 FOR I=1 TO M
1270 PRINT CLS$
1280 PRINT"}} Please enter line #";I;" of the comments:"
1290 PRINT:INPUT M$(I):PRINT
1300 IF IPR=0 THEN 1330
1310 PRINT"  ... ";M$(I):PRINT
1320 GOSUB 500:IF ANS=0 THEN 1270
1330 NEXT I
1340 LPRINT:LPRINT SPC(8);"- THE SAMPLE NUMBER AND THE COMMENTS ARE AS FOLLOWS:"
1350 LPRINT:LPRINT SPC(10);"... ";S2$:LPRINT
1360 FOR I=1 TO M
1370 LPRINT SPC(10);"... ";M$(I)
1380 NEXT I
1390 LPRINT
1400 GOSUB 2360:REM PRINT EQUATIONS
1410 FOR I=1 TO NC
1420 PRINT CLS$
1430 PRINT"}} Please enter the required";NC;" COEFFICIENTS:":PRINT
1440 PRINT"}} Enter B(";I;") ";:INPUT B(I)
1450 IF IPR=0 THEN 1480
1460 PRINT:PRINT"  ... B(";I;")=";:PRINT USING "#####.########";B(I):PRINT
1470 GOSUB 500:IF ANS=0 THEN 1420:REM CORRECTION PROMPT
1480 NEXT I
1490 LPRINT SPC(8);"- THE ";NC;" EQUATION COEFFICIENTS ARE:":LPRINT
1500 FOR I=1 TO NC
1510 LPRINT SPC(10);"... B(";I;")=";:LPRINT USING "#####.########";B(I)
1520 NEXT I
1530 PRINT CLS$
1540 INPUT"}} What is the MINIMUM 'X' for the required iteration";XMIN
1550 PRINT:INPUT"}} What is the MAXIMUM 'X' for the required iteration";XMAX
1560 PRINT:INPUT"}} What is the ITERATION INTERVAL ";DELX
1570 PRINT:INPUT"}} What is the NAME of the 'X' variable";XNAME$
1580 PRINT:INPUT"}} What is the NAME of the 'Y' variable";YNAME$
1590 IF IPR=0 THEN 1660
1600 PRINT:PRINT:PRINT"  ... XMIN=";XMIN
1610 PRINT"  ... XMAX=";XMAX
1620 PRINT"  ... DELX=";DELX
1630 PRINT"  ... 'X' = ";XNAME$
1640 PRINT"  ... 'Y' = ";YNAME$:PRINT
1650 GOSUB 500:IF ANS=0 THEN 1530:REM CORRECTION PROMPT
1660 LPRINT:LPRINT SPC(8);"- THE REQUESTED ITERATION PARAMETERS ARE AS FOLLOWS:"
1670 LPRINT:LPRINT SPC(10);"... XMIN=";XMIN
1680 LPRINT SPC(10);"... XMAX=";XMAX
1690 LPRINT SPC(10);"... DELX=";DELX
1700 XN=(XMAX-XMIN)/DELX
1710 IN=INT(XN+.000001+1)
1720 LN=INT(IN/5)
1730 PRINT CLS$
1740 PRINT"}} AS REQUESTED, THE ABOVE ITERATION PARAMETERS WILL RESULT IN"
1750 PRINT"  ";IN;" PAIRS OF 'X' AND 'Y' DATA PRINTED IN";LN+1 ;" LINES."
1760 PRINT
1770 IF IPR=0 THEN 1790
1780 GOSUB 500:IF ANS=0 THEN 1530:REM CORRECTION PROMPT
1790 PRINT:PRINT"}} Do you want to write this data to"
1800 INPUT"   a file for further processing";R$
```

'CLCEQN.BAS' - APPENDIX III

```
1810 GOSUB 590:IF ANS=1 THEN XFILE=1 ELSE 1840:REM CORRECTION PROMPT
1820 GOSUB 2770:   REM REQUEST DATA FILE
1830 GOSUB 2910:   REM WRITE X,Y DATA TO FILE$
1840 PRINT:PRINT CHR$(7);RD$;
1850 PRINT"}} The calculations are proceeding ... Please wait ...";RF$
1860 GOSUB 3010:   REM DO CALCULATIONS
1870 IF XFILE=0 THEN 1960
1880 PRINT:PRINT"}} ";FILE$;" is being written ... Please wait ..."
1890 FOR I=1 TO IN
1900 SX=X(I):SY=Y(I): REM REDUCE X AND Y TO SINGLE PRECISION FOR PRINTING DATA FILE
1910 PRINT#2,USING"###.######";SX,SY
1920 NEXT I
1930 CLOSE
1940 KILL FILE$
1950 NAME "NEW" AS FILE$
1960 PRINT:LPRINT
1970 LPRINT SPC(6);D126$
1980 LPRINT TAB(40);"TABLE OF CALCULATED VALUES OF 'Y' FOR A RANGE OF GIVEN 'X'"
1990 LPRINT SPC(6);D126$:LPRINT
2000 REM
2010 REM - CALCULATE SPACES TO CENTER VARIABLE NAMES IN TABLE -
2020 REM
2030 LSP=LEN(XNAME$)+LEN(YNAME$)+4
2040 ISP=(135-LSP)/2
2050 LPRINT TAB(ISP);XNAME$;" VS ";YNAME$
2060 LPRINT:LPRINT SPC(8);
2070 LPRINT"  'X'        'Y'             'X'        'Y'             'X'        'Y'             'X'        'Y'             'X'        'Y
'"
2080 FOR I=1 TO IN+2 STEP 5
2090 I1=I+1: I2=I+2: I3=I+3: I4=I+4:
2100 LPRINT USING"     ###.######## ";X(I);
2110 LPRINT USING"###.########   ";Y(I);
2120 LPRINT USING"###.######## ";X(I1);
2130 LPRINT USING"###.########   ";Y(I1);
2140 LPRINT USING"###.######## ";X(I2);
2150 LPRINT USING"###.########   ";Y(I2);
2160 LPRINT USING"###.######## ";X(I3);
2170 LPRINT USING"###.########   ";Y(I3);
2180 LPRINT USING"###.######## ";X(I4);
2190 LPRINT USING"###.########";Y(I4)
2200 NEXT I
2210 LPRINT
2220 LPRINT SPC(6);D126$
2230 LPRINT CHR$(12)
2240 INPUT"}} Is evaluation of another equation required";R$
2250 GOSUB 590:IF ANS=0 THEN 2260:REM CORRECTION PROMPT
2260 PRINT CLS$:END
2270 REM
2280 REM - DEFINE SCREEN CONTROL CODES -
2290 REM  (Currently set for the 'NORTHSTAR ADVANTAGE')
2300 REM
2310 REM   CLEAR SCREEN/INVERSE VIDEO ON\OFF/COMPRESSED PRINT
2320 REM
2330 CLS$=CHR$(4):RD$=CHR$(1):RF$=CHR$(2):CHP$=CHR$(27)+"Q"
2340 RETURN
2350 REM
2360 REM - PRINT LIST OF EQUATIONS -
```

'CLCEQN.BAS' - APPENDIX III

```
2370 REM
2380 PRINT CLS$
2390 PRINT"))) The following equations are available for evaluation:"
2400 PRINT
2410 EQN(1)="    1.  Y = B(1) * X + B(2)"
2420 EQN(2)="    2.  Y = B(1) * X^2 + B(2)*X + B(3)"
2430 EQN(3)="    3.  Y = B(1) * X^(B(2) * X) + B(3)"
2440 EQN(4)="    4.  Y = B(1) * X^(B(2) * X^2) + B(3)"
2450 EQN(5)="    5.  Y = B(1) * EXP(B(2) * X) + B(3)"
2460 EQN(6)="    6.  Y = B(1) * EXP(B(2) * X^2) + B(3)"
2470 EQN(7)="    7.  Y = B(1) * X * EXP(B(2) * X) + B(3)"
2480 EQN(8)="    8.  Y = B(1) * X * EXP(B(2) * X^2) + B(3)"
2490 EQN(9)="    9.  Y = B(1) * X^2 * EXP(B(2) * X) + B(3)"
2500 EQN(10)="   10.  Y = B(1) * X^2 * EXP(B(2) * X^2) + B(3)"
2510 EQN(11)="   11.  Y = B(1) * EXP(B(2) * X) + B(3) * X + B(4)"
2520 EQN(12)="   12.  Y = B(1) * EXP(B(2) * X^2) + B(3) * X + B(4)"
2530 EQN(13)="   13.  Y = (B(1) + B(2)*X)/(1-B(3)*X)"
2540 FOR I=1 TO IE8
2550 PRINT EQN(I)
2560 NEXT I
2570 PRINT
2580 INPUT"))) Which equation is to be evaluated";NEQN
2590 IF IPR(1 THEN 2640
2600 PRINT CLS$
2610 PRINT"))) EQUATION NUMBER ";NEQN;" HAS BEEN CHOSEN. IT READS:"
2620 PRINT:PRINT EQN(NEQN):PRINT
2630 GOSUB 500:IF ANS=0 THEN 2300:REM CORRECTION PROMPT
2640 LPRINT SPC(8);"- EQUATION NUMBER ";NEQN;" HAS BEEN CHOSEN. IT READS:"
2650 LPRINT:LPRINT SPC(10);EQN(NEQN):LPRINT
2660 REM
2670 REM - READ 'NC' THE NUMBER OF COEFFICIENTS CONTAINED IN THE CHOSEN EQUATION -
2680 REM
2690 RESTORE
2700 FOR I=1 TO NEQN
2710 READ NC
2720 NEXT I
2730 RETURN
2740 REM
2750 REM - OPEN DATA FILE -
2760 REM
2770 PRINT CLS:FILES:PRINT:PRINT
2780 PRINT"))) What is the name of your data file"
2790 INPUT"    (DO NOT USE 'NEW' AS A FILENAME)";FILE$
2800 PRINT:INPUT"))) Is this a new file";R$
2810 GOSUB 590:IF ANS=0 THEN 2870:REM CORRECTION PROMPT
2820 RESET
2830 OPEN "O",#1,FILE$
2840 XOLD=0:YOLD=0
2850 PRINT#1,XOLD,YOLD
2860 CLOSE#1
2870 RETURN
2880 REM
2890 REM - SUBROUTINE TO READ PREVIOUS DATA FILE -
2900 REM
2910 OPEN "I",#1,FILE$
2920 OPEN "O",#2,"NEW"
2930 IF EOF(1) THEN 2970
```

'CLCEQN.BAS' - APPENDIX III

```
2940 INPUT#1,SXOLD,SYOLD
2950 PRINT#2,USING"###.###^^^^";SXOLD;SYOLD
2960 GOTO 2930
2970 RETURN
2980 REM
2990 REM - SUBROUTINE TO DO CALCULATIONS -
3000 REM
3010 X(1)=XMIN
3020 REM
3030 N=NEQN
3040 FOR I=1 TO IN
3050 ON N GOTO 3070,3100,3130,3170,3210,3250,3290,3330,3370,3410,3450,3490,3530
3060 REM - EQUATION 1 -
3070 Y(I)=B(1)*X(I)+B(2)
3080 GOTO 3540
3090 REM - EQUATION 2 -
3100 Y(I)=B(1)*X(I)^2+B(2)*X(I)+B(3)
3110 GOTO 3540
3120 REM - EQUATION 3 -
3130 AZ=B(2)*X(I)
3140 Y(I)=B(1)*X(I)^AZ+B(3)
3150 GOTO 3540
3160 REM - EQUATION 4 -
3170 AZ=B(2)*X(I)^2
3180 Y(I)=B(1)*X(I)^AZ+B(3)
3190 GOTO 3540
3200 REM - EQUATION 5 -
3210 AZ=B(2)*X(I)
3220 Y(I)=B(1)*EXP(AZ)+B(3)
3230 GOTO 3540
3240 REM - EQUATION 6 -
3250 AZ=B(2)*X(I)^2
3260 Y(I)=B(1)*EXP(AZ)+B(3)
3270 GOTO 3540
3280 REM - EQUATION 7 -
3290 AZ=B(2)*X(I)
3300 Y(I)=B(1)*X(I)*EXP(AZ)+B(3)
3310 GOTO 3540
3320 REM - EQUATION 8 -
3330 AZ=B(2)*X(I)^2
3340 Y(I)=B(1)*X(I)*EXP(AZ)+B(3)
3350 GOTO 3540
3360 REM - EQUATION 9 -
3370 AZ=B(2)*X(I)
3380 Y(I)=B(1)*X(I)^2*EXP(AZ)+B(3)
3390 GOTO 3540
3400 REM - EQUATION 10 -
3410 AZ=B(2)*X(I)^2
3420 Y(I)=B(1)*X(I)^2*EXP(AZ)+B(3)
3430 GOTO 3540
3440 REM - EQUATION 11 -
3450 AZ=B(2)*X(I)
3460 Y(I)=B(1)*EXP(AZ)+B(3)*X(I)+B(4)
3470 GOTO 3540
3480 REM - EQUATION 12 -
3490 AZ=B(2)*X(I)^2
3500 Y(I)=B(1)*EXP(AZ)+B(3)*X(I)+B(4)
```

'CLCEQN.BAS' - APPENDIX III

```
3510 GOTO 3540
3520 REM - EQUATION 13 -
3530 Y(I)=(B(1)+B(2)*X(I))/(1!-B(3)*X(I))
3540 X(I+1)=X(I)+DELX
3550 NEXT I
3560 X(IN+1)=0!
3570 RETURN
```

'CLCEQN.BAS' - APPENDIX III

SYMBOL	REFERENCE LINE						
500	1110	1230	1320	1470	1650	1780	2630
570	850	1070	1810	2250	2810		
640	950	1050					
650	640	1130					
710	540						
1040	850						
1080	1110						
1120	1090						
1180	1230						
1240	1210						
1270	1320						
1330	1300						
1420	1470						
1480	1450						
1530	1650	1780					
1640	1590						
1790	1770						
1840	1810						
1960	1870						
2260	2250						
2330	760						
2380	1480	2630					
2640	2590						
2770	1820						
2870	2810						
2910	1830						
2930	2960						
2970	2930						
3010	1860						
3070	3050						
3100	3050						
3130	3050						
3170	3050						
3210	3050						
3250	3050						
3290	3050						
3330	3050						
3370	3050						
3410	3050						

'CLCEQN.BAS' - APPENDIX III

SYMBOL	REFERENCE LINE												
3450	3050												
3490	3050												
3530	3050												
3540	3000	3110	3150	3190	3230	3270	3310	3350	3390	3430	3470	3510	
ANS	590	850	1070	1110	1230	1320	1470	1650	1700	1810	2250	2630	2810
AZ	3130	3140	3170	3180	3210	3220	3250	3260	3290	3300	3330	3340	3370
	3380	3410	3420	3450	3460	3490	3500						
B	710												
BK	720	1440	1460	1510	3070	3100	3130	3140	3170	3180	3210	3220	3250
	3260	3290	3300	3330	3340	3370	3380	3410	3420	3450	3460	3490	3500
	3530												
CLSG	670	770	1100	1240	1270	1420	1530	1730	2260	2330	2380	2600	2770
CNPG	1140	2330											
DG	1000	1100	1140										
DI266	750	1150	1170	1970	1990	2220							
DJ40	750	780	800										
DELX	1540	1620	1690	1780	3540								
E	710												
EBK	720	2410	2420	2430	2440	2450	2460	2470	2480	2490	2500	2510	2520
	2530	2550	2620	2650									
FILEG	1000	1940	1950	2790	2830	2910							
I	1260	1280	1290	1310	1330	1360	1370	1380	1410	1440	1460	1480	1500
	1510	1520	1890	1900	1920	2080	2090	2100	2110	2200	2540	2550	2560
	2700	2720	3040	3070	3100	3130	3140	3170	3180	3210	3220	3250	3260
	3290	3300	3330	3340	3370	3380	3410	3420	3450	3460	3490	3500	3530
	3540	3550											
I1	2090	2120	2130										
I2	2090	2140	2150										
I3	2090	2160	2170										
I4	2090	2180	2190										
IEG	740	910	2540										
IN	1710	1720	1750	1890	2080	3040	3560						
IPR	1070	1090	1210	1300	1450	1590	1770	2590					
ISP	2040	2050											
LN	1720	1750											
LSP	2030	2040											
N	1250	1260	1360										
NBK	720	1290	1310	1370									
N	3030	3050											
NC	1410	1430	1490	1500	2710								
NEBN	2500	2610	2620	2640	2650	2700	3030						

'CLCEQN.BAS' - APPENDIX III

SYMBOL	REFERENCE LINE												
R$	500	590	650	660	840	1040	1080	2240	2800				
RF$	1050	2330											
R$$	1040	2330											
SX	1900	1910											
SXOLD	2940	2950											
SY	1900	1910											
SYOLD	2940	2950											
S2$	1200	1220	1350										
X	710	1570	1630	2030	2050								
X(	720	1900	2100	2120	2140	2160	2180	3010	3070	3100	3130	3140	3170
	3180	3210	3250	3290	3300	3330	3340	3370	3380	3410	3420	3450	3460
	3490	3500	3530	3540	3560								
XFILE	1010	1070											
XMAX	1550	1610	1600	1700									
XMIN	1540	1600	1670	1700	3010								
XN	1700	1710											
XOLD	2040	2050											
Y	710	1500	1640	2030	2050								
Y(	720	1900	2110	2130	2150	2170	2190	3070	3100	3140	3160	3220	3240
	3300	3340	3390	3420	3440	3500	3530						
YOLD	2040	2050											

LINES: 348 BYTES: 11007 SYMBOLS: 90 REFERENCES: 390